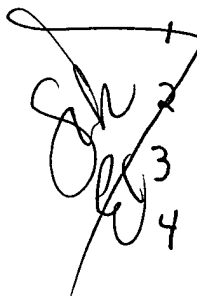


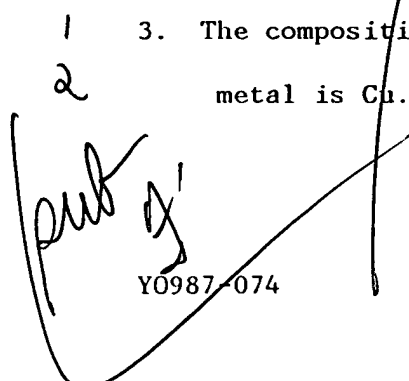
CLAIMS

Having thus described our invention what we claim as new
and desire to secure as Letters Patent, is:

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- 1 1. A superconductive composition having a transition
2 temperature greater than 26°K , the composition in-
3 cluding a rare earth or near rare earth-like ele-
4 ment, a transition metal element capable of
5 exhibiting multivalent states and oxygen, and in-
6 cluding at least one phase that exhibits
7 superconductivity at temperature in excess of 26°K .

- 
2. The composition of claim 1, further including an
alkaline earth element substituted for at least one
atom of said rare earth or rare earth-like element
in said composition.

- 
3. The composition of claim 2, where said transition
metal is Cu.

1 4. The composition of claim 3, where said alkaline earth
2 element is selected from the group consisting of
3 B, Ca, Ba, and Sr.

1 5. The composition of claim 1, where said transition
2 metal element is selected from the group consisting
3 of Cu, Ni, and Cr.

1 6. The composition of claim 2, where said rare earth
2 or rare earth-like element is selected from the
3 group consisting of La, Nd, and Ce.

1 7. The composition of claim 1, where said phase is
2 crystalline with a perovskite-like structure.

1 8. The composition of claim 2, where said phase is
2 crystalline with a perovskite-like structure.

1 9. The composition of claim 1, where said phase exhibits
2 a layer-like crystalline structure.

1 10. The composition of claim 1, where said phase is a
2 mixed copper oxide phase.

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1 11. The composition of claim 1, where said composition
2 is comprised of mixed oxides with alkaline earth
3 doping.

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1 12. A superconducting combination, including a
2 superconductive composition having a transition
3 temperature $> 26^{\circ}\text{K}$,
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5 means for passing a superconducting electrical
6 current through said composition while said compo-
7 sition is at a temperature $> 26^{\circ}\text{K}$., and
8
9 cooling means for cooling said composition to a
superconducting state at a temperature in excess
of 26°K .

1 13. The combination of claim 12, where said
2 superconductive composition includes a transition
3 metal oxide.

1 14. The combination of claim 12, where said
2 superconductive composition includes Cu-oxide.

1 15. The combination of claim 12, where said
2 superconductive composition includes a multivalent
3 transition metal, oxygen, and at least one addi-
4 tional element.

1 16. The combination of claim 15, where said transition
2 metal is Cu.

1 17. The combination of claim 15, where said additional
2 element is a rare earth or rare earth-like element.

1 18. The combination of claim 15, where said additional
2 element is an alkaline earth element.

1 19. The combination of claim 12, where said composition
2 includes a perovskite-like superconducting phase.

1 20. The combination of claim 12, where said composition
2 includes a substituted transition metal oxide.

1 21. The combination of claim 20, where said substituted
2 transition metal oxide includes a multivalent
3 transition metal element.

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1 22. The combination of claim 20, where said substituted
2 transition metal oxide is an oxide of copper.

1 23. The combination of claim 20, where said substituted
2 transition metal oxide has a layer-like structure.

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1 24. A method including the steps of forming a transition
2 metal oxide having a phase therein which exhibits
3 a superconducting state at a critical temperature
4 in excess of 26° K,

5 lowering the temperature of said material at least
6 to said critical temperature to produce said
7 superconducting state in said phase, and

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8 passing an electrical supercurrent through said
9 transition metal oxide while it is in said super-
10 conducting state.

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1 25. The ^{apparatus} ~~method~~ of claim 24, where said transition metal
2 oxide is comprised of a transition metal capable
3 of exhibiting multivalent states.

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1 26. The ^{apparatus} ~~method~~ of claim 24, where said transition metal
2 oxide is comprised of a Cu oxide.

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1 27. A superconducting composition having a transition
2 temperature in excess of 26°K, said composition
3 being a substituted Cu-oxide including a supercon-
4 ducting phase having a structure substantially
5 close to the orthorhombic-tetragonal phase transi-
6 tion of said composition.

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1 28. The ^{superconducting apparatus} ~~composition~~ of claim 27, where said substituted
2 Cu-oxide includes a rare earth or rare earth-like
3 element.

superconducting apparatus

- 1 29. The ~~composition~~ of claim 27, where said substituted
2 Cu-oxide includes an alkaline earth element.

superconducting apparatus

- 1 30. The ~~composition~~ of claim 29, where said alkaline
2 earth element is atomically large with respect to
3 Cu.

superconducting apparatus

- 1 31. The ~~composition~~ of claim 27, where said composition
2 has a crystalline structure which enhances
3 electron-phonon interactions to produce
4 superconductivity at a temperature in excess of
5 26°K.

- 1 32. The composition of claim 31, where said crystalline
2 structure is layer-like, enhancing the number of
3 Jahn-Teller polarons in said composite.

- 1 33. A superconducting composition having a supercon-
2 ducting onset temperature in excess of 26°K., the
3 composition being comprised of a copper oxide doped
4 with an alkaline earth element where the concen-

5 tration of said alkaline earth element is near to
6 the concentration of said alkaline earth element
7 where the superconducting copper oxide phase in
8 said composition undergoes an orthorhombic to
9 tetragonal structural phase transition.

apparatus comprising a

b 34. A superconducting composition having a supercon-
ducting onset temperature in excess of 26°K, the
composition being comprised of a mixed copper oxide
doped with an element chosen to create Cu^{3+} ions
in said composition.

superconducting apparatus

b 35. The ~~composition~~ of claim 34, where said doping el-
ement includes an alkaline earth element.

36. A combination comprising:

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2 a composition having a superconducting onset tem-
3 perature in excess of 26°K, said composition being
4 comprised of a substituted copper oxide exhibiting
5 mixed valence states and at least one other element
6 in its crystalline structure,

7 means for passing a superconducting electrical
8 current through said composition while said compo-
9 sition is at a temperature in excess of 26°K , and

10 cooling means for cooling said composition to a
11 superconducting state at a temperature in excess
12 of 26°K .

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37. The combination of claim 36, where said at least
one other element is an alkaline earth element.

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38. The combination of claim 36, where said at least
one other element is an element which creates Cu^{3+}
ions in said composition.

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39. The composition of claim 36, where said at least
one other element is an element chosen to create
the presence of both Cu^{2+} and Cu^{3+} ions in said
composition.

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- 1 40. A superconductor exhibiting a superconducting onset
2 at a temperature in excess of 26°K, said supercon-
3 ductor being comprised of at least four elements,
4 none of which is itself superconducting.

- b (sub g) 1 41. The ^{apparatus} ~~superconductor~~ of claim 40, where said elements
2 include a transition metal and oxygen.

- b (sub c) 1 42. A ^{apparatus} ~~superconductor~~ having a superconducting onset
2 temperature greater 26°K, said superconductor being
3 a doped transition metal oxide, where said transi-
4 tion metal is itself non-superconducting.

- b 1 43. The ^{apparatus} ~~superconductor~~ of claim 42, where said doped
2 transition metal oxide is multivalent in said
3 superconductor.

- b (sub g) 1 44. The ^{apparatus} ~~superconductor~~ of claim 42, further including
2 an element which creates a mixed valent state of
3 said transition metal.

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apparatus

45. The ~~superconductor~~ of claim 43, where said transition metal is Cu.

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An apparatus comprising

46. A superconductor having a superconducting onset temperature greater than 26°K, said superconductor being an oxide having multivalent oxidation states and including a metal, said oxide having a crystalline structure which is oxygen deficient.

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47. The superconductor of claim 46, where said transition metal is Cu.

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48. A superconductive composition comprised of a transition metal oxide having substitutions therein, the amount of said substitutions being sufficient to produce sufficient electron-phonon interactions in said composition that said composition exhibits a superconducting onset at temperatures greater than 26°K.

1 49. The composition of claim 48, where said transition
2 metal oxide is multivalent in said composition.

1 50. The composition of claim 48, where said transition
2 metal is Cu.

1 51. The composition of claim 48, where said substi-
2 tutions include an alkaline earth element.

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1 52. The composition of claim 48, where said substi-
2 tutions include a rare earth or rare earth-like
3 element.

1 53. A superconductor comprised of a copper oxide having
2 a layer-like crystalline structure and at least one
3 additional element substituted in said crystalline
4 structure, said structure being oxygen deficient
5 and exhibiting a superconducting onset temperature
6 in excess of 26°K.

1 54. The superconductor of claim 53, where said addi-
2 tional element creates a mixed valent state of said
3 copper oxide in said superconductor.

55. A combination, comprising:

2 a transition metal oxide having an oxygen defi-
3 ciency, said transition metal being non-
4 superconducting and said oxide having multivalent
5 states,

6 means for passing an electrical superconducting
7 current through said oxide while said oxide is at
8 a temperature greater than 26°K, and

9 cooling means for cooling said oxide in a super-
10 conducting state at a temperature greater than
11 26°K.

1 56. The combination of claim 55, where said transition
2 metal is Cu.

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57. A combination including;

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a superconducting oxide having a superconducting onset temperature in excess of 26°K and containing at least 3

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non-superconducting elements,

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means for passing a supercurrent through said oxide

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while said oxide is maintained at a temperature greater

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than 26°K, and

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means for maintaining said oxide in a superconducting

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state at a temperature greater than 26°K.

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58. A combination, comprised of:

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a copper oxide superconductor including an element which

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creates a mixed valent state in said oxide, said oxide

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being crystalline and having a layer-like structure,

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means for passing a supercurrent through said copper

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oxide while it is maintained at a temperature greater

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than 26°K, and

8 means for cooling said copper oxide to a superconductive
9 state at a temperature greater than 26°K.

1 59. A combination, comprised of:

2 a superconducting ceramic-like material having an
3 onset of superconductivity at a temperature in ex-
4 cess of 26°K.,

5 means for passing a supercurrent through said
6 superconducting ceramic-like material while said
7 ceramic-like material is maintained at a temper-
8 ature in excess of 26°K., and

9 means for cooling said superconducting ceramic-like
10 material to a superconductive state at a temper-
11 ature greater than 26°K.

1 60. A superconductor comprised of a transition metal
oxide, and at least one additional element, said
superconductor having a distorted crystalline
structure characterized by an oxygen deficiency and

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5 state in said composition, said composition further
6 having a distorted octahedral oxygen environment
7 leading to a T_c greater than 26°K.,
8 means for providing a supercurrent through said
9 composition at temperatures greater than 26°K., and
10 cooling means for cooling said composition to a
11 temperature greater than 26°K.

1 65. A superconducting composition exhibiting
2 superconductivity at temperatures greater than
3 26°K, said composition being a ceramic-like mate-
4 rial in the RE-AE-TM-O system, where RE is a rare
5 earth or near rare earth element, AE is an alkaline
6 earth element, TM is a multivalent transition metal
7 element having at least two valence states in said
8 composition, and O is oxygen, the ratio of the
9 amounts of said transition metal in said two va-
10 lence states being determined by the ratio RE : AE.

1 66. A superconductive composition having a transition
2 temperature greater than 26°K, the composition in-

3 cluding a multivalent transition metal oxide and
4 at least one additional element, said composition
5 having a distorted orthorhombic crystalline struc-
6 ture.

1 67. The composition of claim 66, where said transition
2 metal oxide is a mixed copper oxide.

1 68. The composition of claim 67, where said one addi-
2 tional element is an alkaline earth element.

1 69. A superconductive combination, comprising:
2 a superconducting composition exhibiting a super-
3 conducting transition temperature greater than
4 26°K, said composition being a transition metal
5 oxide having a distorted orthorhombic crystalline
6 structure, and

7 means for passing a superconducting electrical
8 current through said composition while said compo-
9 sition is at a temperature greater than 26°K.

1 70. The combination of claim 69, where said transition
2 metal oxide is a mixed copper oxide.

1 71. The combination of claim 70, where said mixed copper
2 oxide includes an alkaline earth element.

1 72. The combination of claim 71, where said mixed copper
2 oxide further includes a rare earth or rare earth-
3 like element.

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1 73. A method for making a superconductor having a
2 superconducting onset temperature $> 26^{\circ}\text{K}$, said
3 method including the steps of:

4 preparing powders of oxygen-containing compounds
5 of a rare earth or rare earth-like element, an
6 alkaline earth element, and copper,

7 mixing said compounds and firing said mixture to
8 create a mixed copper oxide composition including
9 said alkaline earth element and said rare earth or
10 rare earth-like element, and

11 annealing said mixed copper oxide composition at
12 an elevated temperature less than about 950°C in
13 an atmosphere including oxygen to produce a super-
14 conducting composition having a mixed copper oxide
15 phase exhibiting a superconducting onset temper-
16 ature greater than 26°K, said superconducting com-
17 position having a layer-like crystalline structure
18 after said annealing step.

1 74. The method of claim 73, where the amount of oxygen
2 incorporated into said composition is adjusted by
3 said annealing step, the amount of oxygen therein
4 affecting the critical temperature T_c of the
5 superconducting composition.

1 75. A method for making a superconductor having a
2 superconducting onset temperature greater than
3 26°K, said superconductor being comprised of a rare
4 earth or rare earth-like element (RE), an alkaline
5 earth element (AE), copper (CU), and oxygen (O) and
6 having the general formula RE-AE-CU-O, said method
7 including the steps of combining said rare earth
8 or rare earth-like element, said alkaline earth

9 element and said copper in the presence of oxygen
10 to produce a mixed copper oxide including said rare
11 earth or rare earth-like element and said alkaline
12 earth element therein, and

13 heating said mixed copper oxide to produce a
14 superconductor having a crystalline layer-like
15 structure and exhibiting a superconducting onset
16 temperature greater than 26°K, the critical tran-
17 sition temperature of said superconductor being
18 dependent on the amount of said alkaline earth el-
19 ement therein.

1 76. The method of claim 75, where said heating step is
2 done in an atmosphere including oxygen.

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77. A combination, comprising:
2 a mixed copper oxide composition including an
3 alkaline earth element (AE) and a rare earth or
4 rare earth-like element (RE), said composition
5 having a layer-like crystalline structure and
6 multi-valent oxidation states, said composition

7 exhibiting a substantially zero resistance to the
8 flow of electrical current therethrough when cooled
9 to a superconducting state at a temperature in ex-
10 cess of 26°K, and

11 electrical means for passing an electrical super-
12 current through said composition when said compo-
13 sition exhibits substantially zero resistance at a
14 temperature greater than 26°K.

1 78. The combination of claim 77, where the ratio
2 (AE,RE) : Cu is substantially 1:1.

1 79. The combination of claim 77, where the ratio
2 (AE,RE) : Cu is substantially 1:1.

1 80. The combination of claim 77, where said crystalline
2 structure is perovskite-like.

1 81. The combination of claim 77, where said mixed copper
2 oxide composition has a non-stoichiometric amount
3 of oxygen therein.

1 82. A method for making a superconductor having a
2 superconducting onset temperature greater than 26°,
3 said superconductor being comprised of a rare earth
4 or rare earth-like element (RE), an alkaline earth
5 element (AE), a transition metal element (TM), and
6 oxygen (O) and having the general formula
7 RE-AE-TM-O, said method including the steps of
8 combining said rare earth or rare earth-like ele-
9 ment, said alkaline earth element and said transi-
10 tion metal element in the presence of oxygen to
11 produce a mixed transition metal oxide including
12 said rare earth or rare earth-like element and said
13 alkaline earth element therein, and

14 heating said mixed transition metal oxide to
15 produce a superconductor having a crystalline
16 layer-like structure and exhibiting a supercon-
17 ducting onset temperature greater than 26°K, said
18 superconductor having a non-stoichiometric amount
19 of oxygen therein.

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83. The method of claim 82, where said transition metal is copper.

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84. A superconducting combination, comprising:

a mixed transition metal oxide composition containing a non-stoichiometric amount of oxygen therein, a transition metal and at least one additional element, said composition having substantially zero resistance to the flow of electricity therethrough when cooled to a superconducting state at a temperature greater than 26°K, and

9 electrical means for passing an electrical super-
10 current through said composition when said compo-
11 sition is in said superconducting state at a
12 temperature greater than 26°K.

1 85. The combination of claim 84, where said transition metal is copper.

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1 86. A method, comprising the steps of:

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2 forming a composition including a transition metal,
3 a rare earth or rare earth-like element, an
4 alkaline earth element, and oxygen, where said
5 composition is a mixed transition metal oxide hav-
6 ing a non-stoichiometric amount of oxygen therein
7 and exhibiting a superconducting state at a tem-
8 perature greater than 26°K,
9 cooling said composition to said superconducting
10 state at a temperature greater than 26°K, and
11 passing an electrical current through said compo-
12 sition while said composition is in said supercon-
13 ducting state.

1 87. The method of claim 86, where said transition metal
2 is copper.

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88. A method, including the steps of:
2 forming a composition exhibiting a superconductive
3 state at a temperature in excess of 26°K,

4 cooling said composition to a temperature in excess
5 of 26°K at which temperature said composition ex-
6 hibits said superconductive state, and
7 passing an electrical current through said compo-
8 sition while said composition is in said
9 superconductive state.

1 89. The method of claim 88, where said composition is
2 comprised of a metal oxide.

1 90. The metal of claim 88, where said composition is
2 comprised of a transition metal oxide.

91. (ADDED) A combination, comprising:

a composition exhibiting the onset of a DC substantially zero resistance state at an onset temperature in excess of 30K, and

means for passing an electrical current through said composition while it is in said substantially zero resistance state.

92. (ADDED) The combination of claim 91, where said composition is a copper oxide.

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93. (ADDED) An apparatus, comprising:

a mixed copper oxide material exhibiting an onset of superconductivity at an onset temperature greater than 26K, and

means for producing an electrical current through said copper oxide material while it is in a superconducting state at a temperature in excess of 26K.

94. (ADDED) The apparatus of claim 93, where said copper oxide material exhibits a layer-like crystalline struc-

95. (ADDED) The apparatus of claim 93, where said copper
oxide material exhibits a mixed valence state.

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